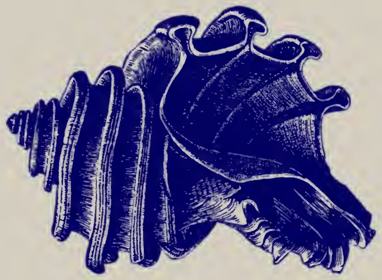
THINGS of science



FOSSILS

Created and distributed without profit by Science Service, Inc., 1719 N Street, N.W., Washington, D. C. 20036. E. G. Sherburne, Jr., Director. Ruby Yoshioka, Editor.

FOSSILS FROM THE MARYLAND MIOCENE

The fossils in this unit have been gathered from the Miocene deposits of Maryland which were formed some 12 to 28 million years ago. From the geological standpoint, fossils from the Miocene are "recent." If you will look at the Geologic Time Scale shown on page 4, and note the position of the Miocene epoch you can see why this is so. Fossil records cover perhaps a billion years of time.

Most of the Miocene fossils have been bleached white, but have not been replaced by minerals because they have not been on earth long enough for this very slow process to take place. Many of these fossils, therefore, appear similar to modern shells and are apt to be overlooked by the casual observer or beachcomber.

The Miocene fossils of Maryland were first studied in 1685 by a European scientist, Martin Lister, who published a paper in which one of the Maryland Miocene fossils was discussed. It was the first time an American fossil was the subject of a scientific paper.

Among the earlier scientists interested

in the Maryland Miocene faunas were Thomas Say, Timothy Conrad and William Dall. Two of our early Presidents, Madison and Jefferson, were ardent fossil collectors in Southern Maryland and have species from that area named after them.

The Miocene deposits underlie many of the Maryland counties adjoining the southern part of Chesapeake Bay and all of Calvert and St. Marys Counties. Outcrops of three formations are found along this area. These are known as the Calvert, Choptank and St. Marys formations, from oldest to youngest.

The great majority of the more than 400 species of Miocene fossils of Maryland are invertebrates belonging to the phylum Mollusca which includes the gastropods (snails) and pelecypods (clams, oysters). Other invertebrate fossils such as bryozoans, coelenterates (corals) and brachiopods are also found in the deposits.

Vertebrate fossils are quite numerous in the Maryland Miocene and include an assortment of whale, shark, stingray and fish remains in the form of hard parts such as teeth and bones.

The fossils in this unit include specimens from both invertebrate and vertebrate forms.

GEOLOGIC TIME SCALE

Era	*Period*	*Epoch*	*Time (approx. duration in years)*	*Years Ago (approx. millions)*
CENOZOIC	Quarternary	Recent Pleistocene	1,000,000	1
	Tertiary	Pliocene	11,000,000	1-12
		Miocene	16,000,000	12-28
		Oligocene	12,000,000	28-40
		Eocene	10,000,000	40-50
		Paleocene	10,000,000	50-60
MESOZOIC	Cretaceous		70,000,000	60-130
	Jurassic		25,000,000	130-155
	Triassic		30,000,000	155-185
PALEOZOIC	Permian		25,000,000	185-210
	Carboniferous			
	Pennsylvanian		25,000,000	210-235
	Mississippian		30,000,000	235-265
	Devonian		55,000,000	265-320
	Silurian		40,000,000	320-360
	Ordovician		80,000,000	360-440
	Cambrian		80,000,000	440-520
PRECAMBRIAN				

Species of fossils usually have three words in their scientific nomenclature. The first word gives the name of the genus to which the fossil belongs; the second is the specific name of the species; the last word is the name of the person who first recognized the species as a distinctive unit and provided a scientific description of it. The author's name is often omitted.

When only the genus is given with *sp.* (abbreviation for species) following, as with some specimens in this unit, it means the species is not specified.

First identify your specimens.

CORAL—*Astrhelia palmata* Goldfuss; large white specimen with circular depressions on the surface.

PELECYPOD—*Astarte sp.;* shell of bivalve.

GASTROPOD—*Turritella plebia* Say; long cone-shaped snail shell; grayish or white.

GASTROPOD—*Nassarius sp.;* stubby short snail shell; grayish or white.

SHARK TOOTH—*Galeocerdo sp.;* dark triangular shaped specimen.

WHALE BONE—Rock-like specimen of no particular shape; porous surface.

CORALS

Corals are invertebrate animals that became established in the early Paleozoic Era about 500 million years ago. They belong to the phylum Coelenterata, class Anthozoa, in biological classification and inhabit shallow warm waters.

Coelenterates are very simple aquatic invertebrates having well-developed body tissues, but lacking advanced organ systems such as the respiratory, circulatory, excretory and nervous systems. The chief groups among the coelenterates are hydroids, sea anemones, jellyfishes and corals.

The bodies of coelenterates consist of a two-layered wall formed into a sac-like hollow that serves as the digestive organ. A single opening, the mouth, from which soft tentacles extend, acts as both an entrance and exit. Sea anemones and jellyfish lack hard parts, but corals secrete a limy substance, calcium carbonate, to form a hard skeletal structure that supports their soft bodies.

Some coelenterates swim about freely. However, corals are attached to the sea bottom throughout their lives. Because they cannot move around in search of food and depend for their survival on any prey

that happens to pass by in the waters sifting through their systems, corals are known as "food sifters."

Many corals, like the specimen in your unit, grow in large colonies. Their skeletal remains, together with calcareous deposits of algae and other organisms, form the coral reefs, huge beds of jagged rock that have endangered ships at sea since ages past.

Experiment 1. Examine the piece of coral in your unit. It is a specimen of *Astrhelia palmata* Goldfuss from the Choptank formation of the Maryland Miocene. The fragment of coral is called a corallum and consists of the skeletal remains of a coral colony. Note the bleached white appearance of the corallum. The white rock-like material is mainly calcium carbonate or calcite secreted by the coral.

The circular depressions you see on the surface are the remains of the individual coral polyps that once lived in this colony and are called corallites. Individual corals are tiny animals, as you can see, only a few millimeters in size.

Astrhelia palmata belongs to the order Scleractinia which includes both solitary and colonial corals. The scleractinians are

ancestors of the modern corals and are common in many Mesozoic and Cenozoic rocks. The oldest known are found in the Middle Triassic, the period during which it is believed these corals first became established, about 170 million years ago.

Experiment 2. Look closely at the corallites with a magnifying glass.

Inside the corallite you will see fine walls extending from the edge to the center or axis. These are the septa, the skeletal partitions that helped hold the soft coral animal in its outer skeleton and also increased the surface area of the animal's soft parts to absorb food more efficiently.

Note that the upper edge of the septa near the top of the corallite forms a bowl-shaped depression. This is known as the calyx.

Experiment 3. Scleractinians are radially symmetrical, a characteristic of all coelenterates, and are basically hexameral in structure. That is, their parts are organized in groups of six. This is evident in the septa which come in pairs of six in many species of Scleractinia. You may find some corallites in your specimen with septa clearly defined. Are they in mul-

tiples of six?

Experiment 4. Look closely around the outer edges of the mouth of the corallite. Can you see fine lines radiating outward from the periphery of the calyx? These are impressions left by the tentacles that extended from the mouth.

Experiment 5. Take your corallum and look at the broken ends of the specimen. You can see the skeletons of the many corallites that compose the corallum. Corals reproduce both sexually and asexually. Asexual reproduction in colonial corals, as in the *Astrhelia palmata,* is accomplished by the profuse formation of buds on the sides of the corallites. As they bud, one from another, they may form branches in any direction.

MOLLUSCA

The phylum Mollusca is a large and important group of invertebrates. It includes clams, mussels, oysters and an endless variety of aquatic and terrestrial snails.

Mollusks are bilateral animals with soft bodies and a hard outer covering. A muscular structure used for locomotion called a foot extends from the body which is covered by a thin layer of tissue, the

mantle, that secretes calcium carbonate to form the hard outer shell or exoskeleton. Higher up in the biological scale than corals, mollusks are equipped with simple digestive, excretory and nervous systems and gills for breathing.

There are five main classes of mollusks, specimens from two of which, the pelecypods and gastropods, are included in this unit.

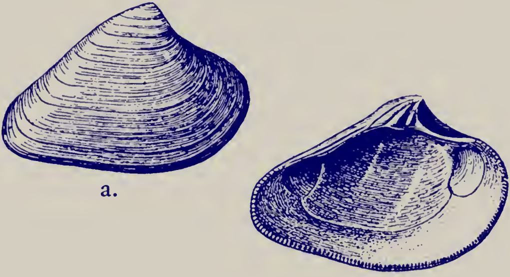
PELECYPODS

Pelecypods are bivalves, two-shelled animals, that include clams and oysters. They have existed on earth since Paleozoic times without much change in structure. The shells enclose the soft bodies of the mollusk entirely and are usually the same size and mirror images of each other. The name "clam" is often applied to all pelecypods. Your clam specimen, a species of *Astarte,* belongs to this group. The shell in your unit, therefore, is one-half of the exoskeleton of the animal.

The bodies of pelecypods have a right and left side, but no head or eyes. Pelecypods feed through tubes known as siphons which extend from the mantle. Water containing tiny food materials is sucked in through the siphon and passes through

the mouth where the edible parts are devoured. Oxygen from the water is absorbed by the gills as the water goes through the system. Undesired material and water are discharged through a second siphon which serves as the outlet.

Although casts and molds of pelecypods are common, most recent pelecypod fossils are shells. The pearly luster of the in-



a.

b.

Fig. 1

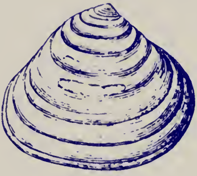


Fig. 2

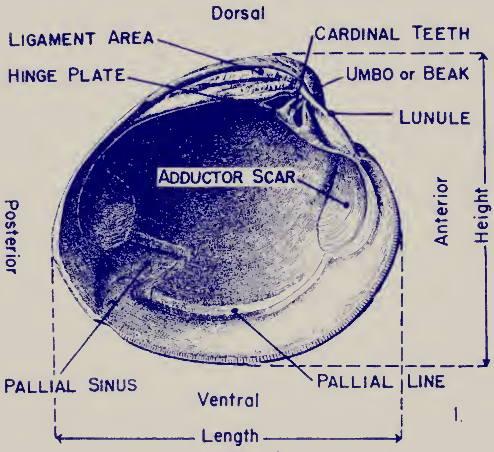


Fig. 3

side surface of the shell usually disappears during fossilization.

Experiment 6. Examine your specimen of a pelecypod. It is one of a species of *Astarte* collected for this unit from the Calvert and Choptank formations. It is between 12 and 28 million years old. Compare your specimen with the illustrations in Figures 1 and 2. Your specimen may be *Astarte cuneiformis* Conrad (Figs. 1a and 1b) from the Calvert formation or *Astarte thisphila* Glenn, a species abundant in the Choptank deposits (Fig. 2).

Astarte cuneiformis is characterized by its elongated triangular shape that comes to a sharp point at the apex or beak. *Astarte thisphila* is more rounded in shape, and the beak is not as pointed.

Experiment 7. The shell of a clam grows at intervals marked by rest periods. These rest periods are indicated by lines or ridges on the outside of the shell. The ridges are quite distinct and you can readily observe them in your specimen. The ridges are pronounced in *Astarte thisphila.*

Experiment 8. Look inside the shell. Can you find the hinge plate (Fig. 3) where the two shells of the bivalve were once hinged together?

See if you can locate the muscle scars, one on each side of the shell. These are the flat areas to which the strong adductor muscles were attached. The muscles, when contracted, close the valves and an elastic ligament attached near the beak causes the shells to open when the adductor muscles are relaxed (Fig. 3).

Experiment 9. Along the edge of the inside of the shell opposite the hinge, you will see a flattened area. The line forming the inner edge of this flat area is known

as the pallial line (Fig. 3). This is where the mantle was attached to the shell.

Experiment 10. The clam's two siphons project from the posterior part of the shell when the animal is feeding and are retracted when the valves are closed. An indentation occurs in the pallial line to allow for the pallial sinus, the space occupied by the retracted siphons. Can you find this on your specimen?

Many fossil shells have a single round hole. Does yours have one? The hole was probably left by a carnivorous gastropod that drilled through the shell to reach its victim.

The *Astarte* are very common in the Maryland Miocene and serve as diagnostic guide fossils for the various formations.

GASTROPODS

The class gastropods of the phylum Mollusca includes snails that bear a single calcareous shell and also slugs which have no hard parts.

Snails are abundant in the Maryland Miocene faunas but are found mostly in the St. Marys formation. The two specimens in your unit, *Turritella plebia* Say and *Nassarius sp.,* are both from the St.

Marys formation.

The snail carries its shell with the opening forward and the tip pointing backward. Its soft body extends back into the shell and is firmly attached to the inside. Gastropods vary in size from very small up to two feet. Originally, they were all aquatic but during the Mesozoic and Cenozoic eras, many species became adapted to living on dry land.

The gastropod, unlike the pelecypod, has a head with paired horns usually above the mouth. Some species may have eyes.

The snails crawl along the ground on a muscular foot. As with the clams, the body is covered by a mantle which secretes the calcareous substance for building the outer shell. The shell may be coiled or uncoiled. The specimens in your unit are both coiled types.

Turritella plebia Say

The genus *Turritella* is the most abundant of the gastropods in the Maryland Miocene faunas and is found in all three formations. However, *Turritella plebia,* like the specimen in your unit, is found only in the St. Marys formation.

Experiment 11. Examine the shell of *Turritella plebia.* Observe the bleached appearance.

Snail shells are commonly coiled in the shape of a cone, wider at the opening or aperture and pointed at the apex. This form of coiling is referred to as the conispiral form.

Most conispiral shells are orthostrophic, or spiral upward from the aperture. Follow the coil on your specimen and you will see that it winds upward to the tip. A few species coil downward from the apex. Such shells are termed hyperstrophic.

An imaginary line drawn from the tip

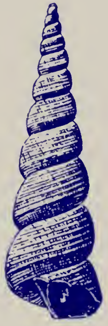


Fig. 4

of the coil down through the shell to the base is called the axis of coiling. Note that the coil narrows in width as it progresses to the tip and that its surface is somewhat rounded or convex. The latter feature is characteristic of the *Turitella plebia* found in the St. Marys formation.

Experiment 12. Trace the coil for one complete turn (360 degrees) around the shell. One full turn of a coil is referred to as a whorl.

The last complete whorl at the bottom of the shell starting from the aperture is known as the body whorl (Fig. 4). Locate the body whorl in your specimen. The remaining whorls to the apex, grouped together, compose the spire.

The distinct depressions between the coils are called sutures. Look closely at the sutures in your specimen. Sutures may vary in width and depth depending on the species of gastropod.

Experiment 13. Do you see fine uniformly spaced ribs on the surface of the whorls parallel to the direction of the coiling? There are several variations of *Turritella plebia,* but the species with these spiral ribs are the only kind found in the St. Marys formation.

Experiment 14. Examine the aperture of the shell. The inner edge of the aperture, the side next to the axis of coiling, is called the inner lip while the outer side of the aperture is referred to as the outer lip. A thickened part of the shell just in front of the inner lip is designated the callus (Fig. 5).

Experiment 15. Examine the coils carefully and look for transverse lines on parts of the body whorl and the spire.

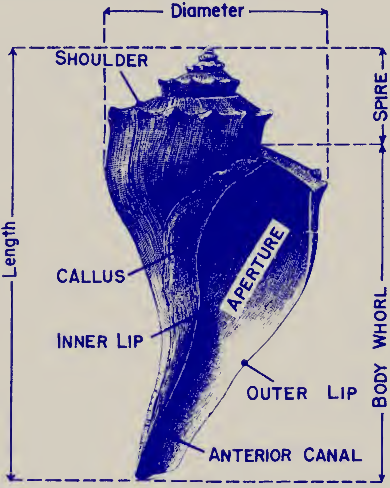


Fig. 5

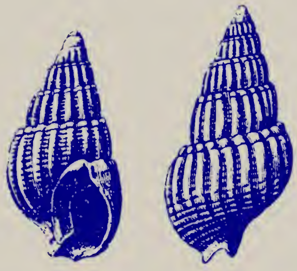


Fig. 6

These are growth lines of the shell. Note that the growth lines follow the outline of the aperture lip.

Nassarius sp.

The smaller gastropod in your unit is a species of *Nassarius*. *Nassarius* are carrion feeders living on decaying fish or other food materials. The specimen in your unit is a species from the St. Marys formation (Fig. 6).

Experiment 16. Examine the parts of the *Nassarius* as you did the *Turritella* comparing the two, noting their differences and similarities. Is it conispiral and orthostrophic?

Experiment 17. Very distinct transverse ribs are present on the whorls of the *Nassarius*. These are due to fine elevations

produced by localized thickening of the shell.

Observe the distinct sutures noting how they extend outward slightly to form a shelf.

Experiment 18. In the *Nassarius* you will see a tubular-like structure coiled and open at one side, extending from the aperture. This is called the canal and enclosed the siphon during the lifetime of the animal.

Experiment 19. Can you see growth lines near the aperture? Do the lines differ in direction with reference to the whorls from the growth lines of the *Turritella?*

(The cover picture shows the shell of the gastropod *Ecphora quadricostata* Say of the St. Marys formation. This is the fossil that figured in the work by Lister. The large shells are characterized by their four T-shaped ribs.)

SHARK TEETH

Sharks first appeared in the Devonian period about 300 million years ago. They belong to the phylum Chordata which includes all vertebrate animals and those that have a dorsal nerve cord at some time during their life.

These fish-like animals were not very well represented during the early Mesozoic period, but gained in variety and numbers during the Jurassic and Cretaceous periods, becoming most prevalent during the Triassic period of the Cenozoic era.

Sharks are characterized by a cartilagenous internal skeletal structure. Cartilage is skeletal structure that does not contain calcium and is soft and flexible. Since cartilage deteriorates very quickly, the teeth and bony scale are the only fossil parts usually remaining of sharks although some calcified cartilage may become fossilized.

Several genera and species of sharks are found in the Maryland Miocene. These sharks varied widely in size from a few feet to perhaps 70 feet in length. The largest of these, the *Carcharodon megalodon,* weighed about 70 tons at full growth and was of the same size as the large whales of today.

The specimen of shark tooth in your unit is from a species of the genus *Galeocerdo,* one of the smaller sharks that flourished in the area we now recognize as the Chesapeake Bay. The specimens for this unit were collected from the Calvert

and Choptank formations (Fig. 6).

Experiment 20. Examine your shark tooth carefully. Figure 7 contains an illustration of typical teeth of *Galeocerdo sp.*

Fig. 7

The color of the teeth of this shark may vary from brown to dark gray or black. Note the pointed tooth with its smooth texture and the root opposite. Some specimens have small serrated edges along one side just above the root.

WHALE BONE

The whales—Order Cetacea—are mammals that were once terrestrial but took to aquatic living. Like other mammals, they are warm-blooded, have lungs and their young are born alive.

The exact origin of whales is still a mystery and their ancestry is completely unknown at the present time. They are believed to have ancient predecessors, but no fossil record of a representative to which they can be directly related has

been found. They appeared suddenly in early Tertiary times already highly specialized and adapted to aquatic life. Modern whales are descended from these whales.

By the Miocene epoch many species of modern whales had appeared. Largest of vertebrate animals, they may attain a length of 100 feet and weigh up to 150 tons.

Fossil remains of whales are common in Miocene strata. Your specimen came from either the Calvert or Choptank formation.

Experiment 21. Observe that the specimen has preserved the original cellular structure of the bone. Examine the surface with a magnifying glass and note how solidly the bone is filled with material.

The soft substances within the whale bone disappeared and the spaces became filled, molecule by molecule through millions of years, by various minerals characteristic of the location. Some bones contain iron minerals and are black. Other

specimens may be brown or gray depending upon the particular minerals deposited.

Note the rock-like appearance of the bone.

For further reading on the Maryland Miocene the following reference will be very helpful.

Miocene Fossils of Maryland, Bulletin 20, Maryland Geological Survey, The Johns Hopkins University, Baltimore, Maryland. Figures 1 through 7 and cover picture were reproduced from this reference with the permission of the Maryland Geological Survey.

The specimens in this unit were collected by Donald Malick, Malicks' Fossils, 5514 Plymouth Rd., Baltimore, Md. 21214. Appreciation is expressed to Mr. Malick for his cooperation and for reviewing this booklet.

* * *

........cut out label on other side and paste on box........